# Distributed Generation Impacts on the GBSO

21st October 2014

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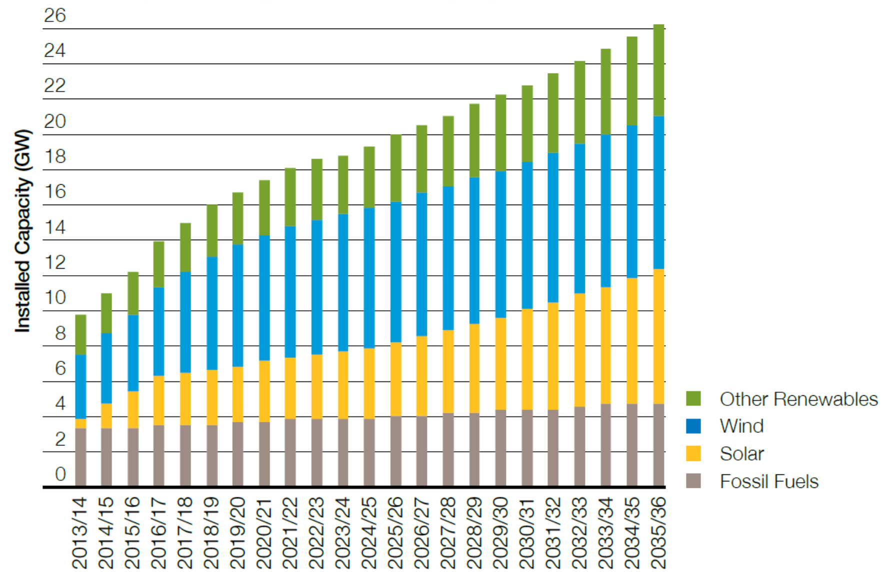
# Introduction

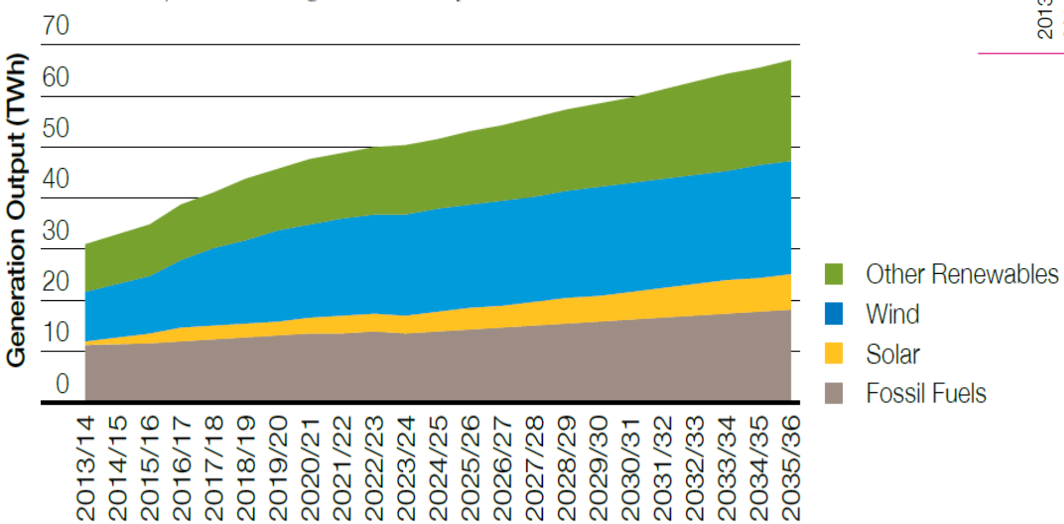
- Distributed generation is being encouraged and incentivised
- Many technologies:
  - CHP, Coal, Diesel, Gas, Oil
  - Wind, Solar, Biomass, Wave

*Low Carbon Life distributed generation installed capacity*




*Source: UK Future Energy Scenarios*

*Low Carbon Life distributed generation output*




- Over 22GW (generators > 1MW) by 2030
- Wind & Solar predominate

*Source: UK Future Energy Scenarios*

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# Challenges for System Operator

**Impacts from a Transmission System Operator perspective:**

- Changes to demand and flows on the transmission network
- Generation & demand forecasting is more complex due to limited information and generation unpredictability
- Voltage & frequency management is more challenging, particularly during lightly loaded conditions
- System dynamics: variable real-time output, lower inertia
- Impacts on capacity requirements (e.g transformers)
- Power quality issues including short-term abnormal voltage, harmonics

**We are innovating to address many of these challenges**

# Forecasting Windpower

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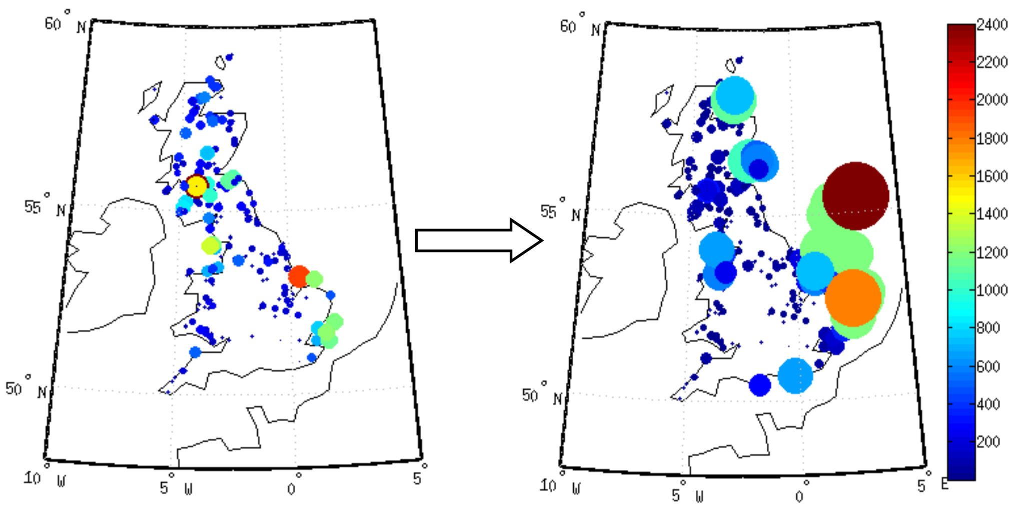
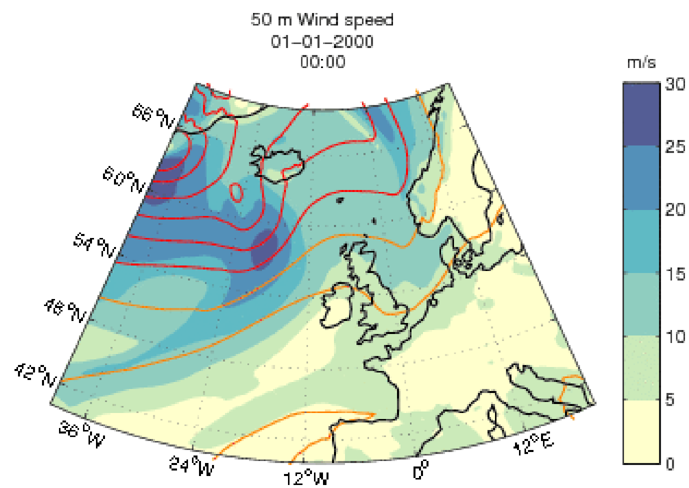
## NGET0085 – UK Wind: Extreme Behaviour & Predictability
## Partner – University of Reading




- Wind farms are becoming wider, more dispersed
- Inevitable wind forecasting errors
- We want to improve accuracy




Orange: Surface pressure >= 1010 hPa (in 10 hPa intervals)
Red: Surface pressure <= 1000 hPa (in 10 hPa intervals)
Shading indicates wind speed (in m/s)

- This work examines new ways to minimise forecast error during extreme weather events. This is to improve the accuracy of wind power predictions as well.

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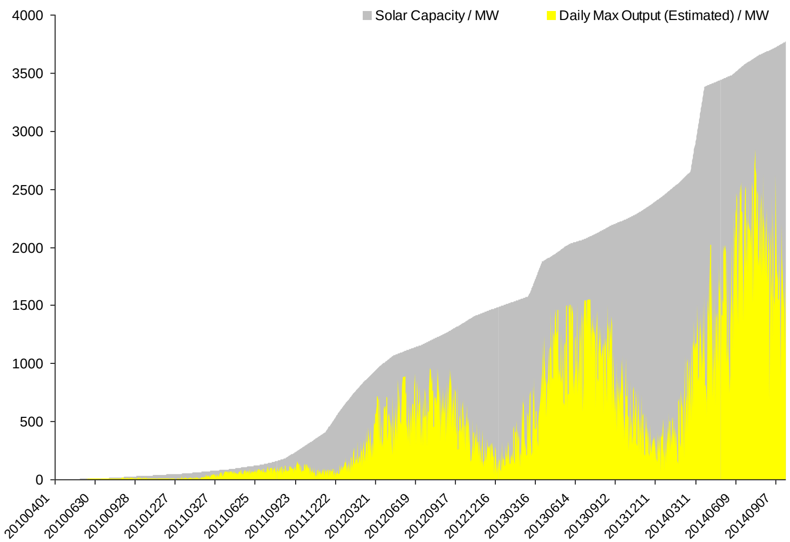
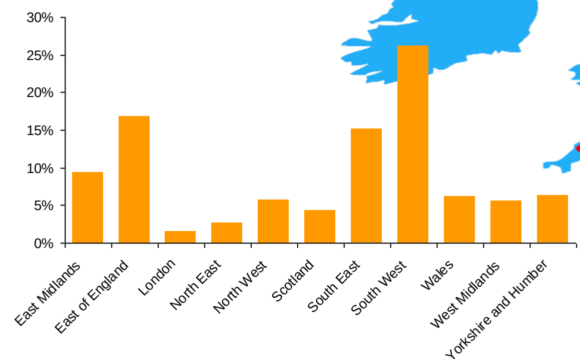
# Forecasting PV Generation
## NGET0139 – PV Monitoring Phase 1




- PV – with little visibility or detailed information, forecasting is inaccurate
- Demand forecasting error is increasing

- The project will collect PV and weather data from test sites.
- Different approaches to PV forecasting will be assessed.
- If viable, a wider scale roll-out will be considered.

# Voltage Management

## NGET0100 Reactive Power Exchange (REACT)

## Partners – DNO's & University of Manchester

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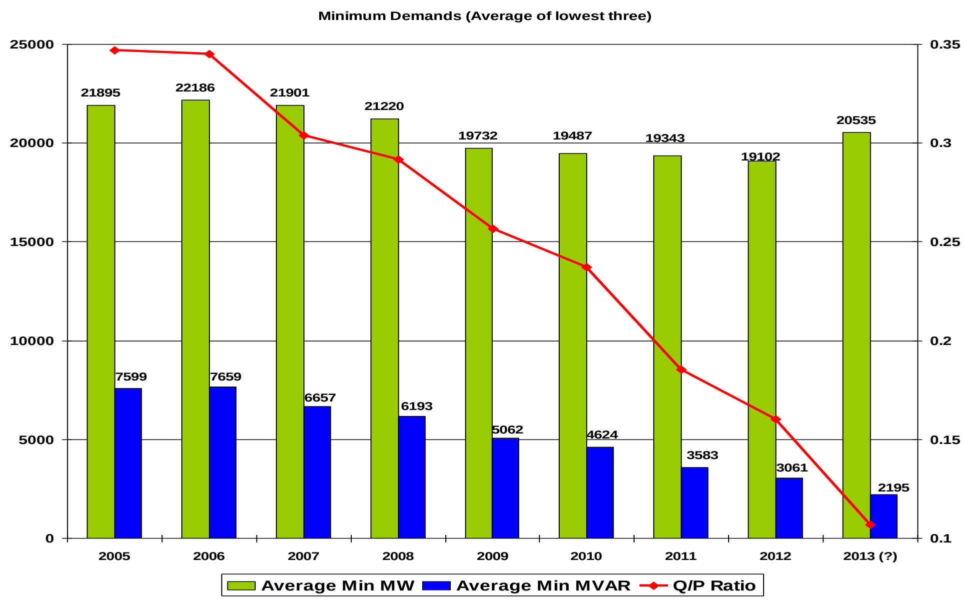



**Minimum demand (average of lowest three)**

- Q/P ratios have declined from 0.35 to 0.1
- Problems when demand is low
- Problems for DNOs as well as National Grid

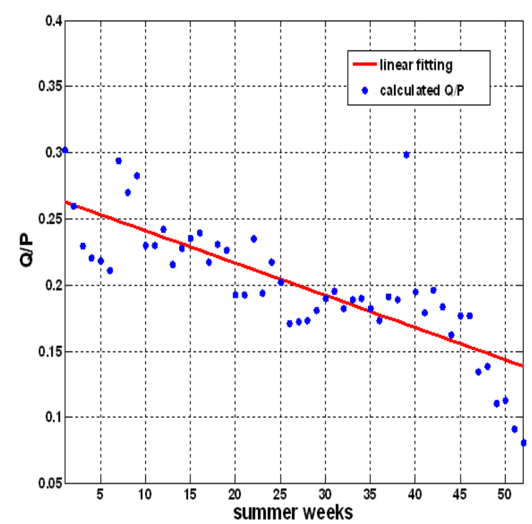
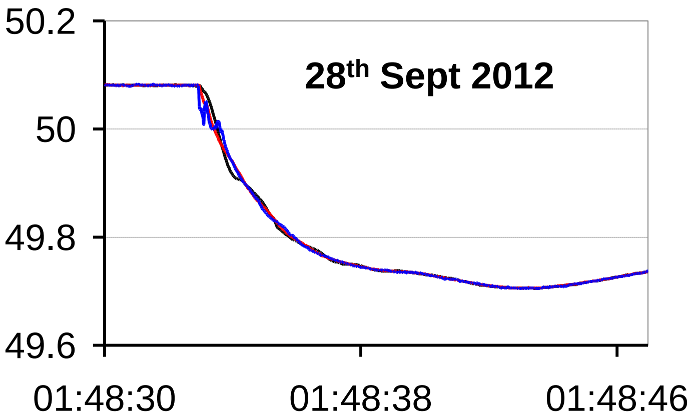


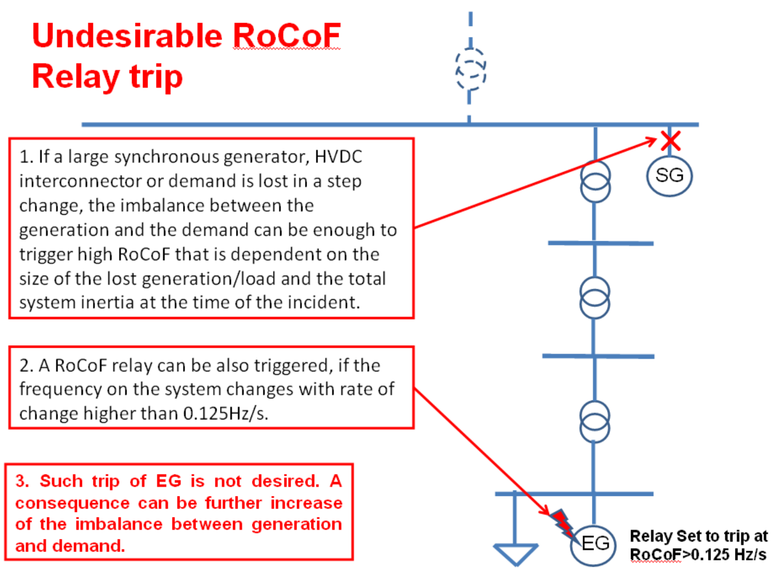

Fig. 5. Fitting of weekly Q/P ratios for City Road GSP (London area - UKPN) during summer for years 2009-2012.

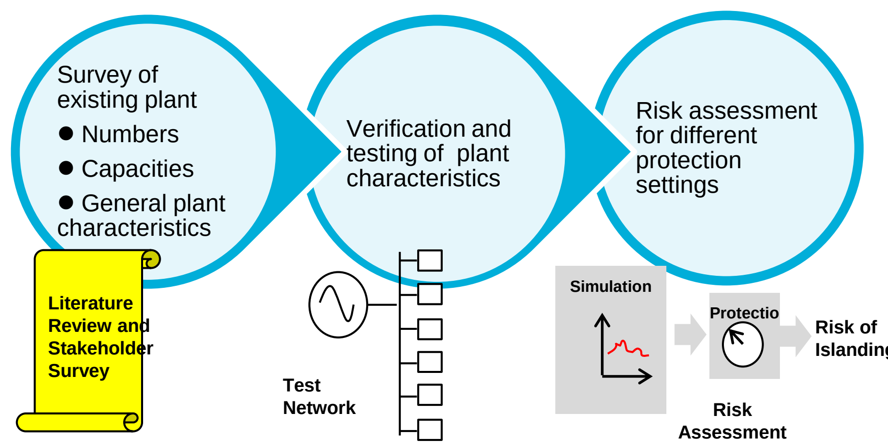
- Understanding these changes will enable us to forecast and mitigate voltage impacts.
- Factors include distributed generation, increased network undergrounding.

# Frequency Management
## NGET0142 - Distributed Generation Behaviour
## Partners – Ecofys & University of Strathclyde




- Increasingly we have lower system inertia.
- Constraining the largest infeed to avoid RoCoF issues is expensive
- Req’ts for gen’s > 5MW changed
- This work will help determine the approach for smaller generators.
- Better information & innovative modelling to assess costs, benefits & risks



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# In summary

- Increasing levels of distributed generation are introducing new challenges for system operation.
- Through the NIA projects we have initiated, we aim to help maintain network security and limit the impact on costs going forward.
  - Generation & demand forecasting projects
  - Reactive power exchange project
  - RoCoF modelling & requirements project